

DETAILED ACTION

Examiner's Amendment

1. An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephone interview with Michael Makuch (Reg. No. 32,263) on 6/3/10.

2. The application has been amended as follows (line numbers cited count fully deleted lines):

- In claim 1, at line 8, **delete** "thin" after "protective layer a".
- In claim 16, at line 2, **delete** "thin" -- after "depositing the".
- In claim 16, at line 3, **delete** "thin " and **insert** -- first -- after "depositing a".
- In claim 16, at line 5, **delete** "thin " and **insert** -- second -- after "depositing a".

Allowable Subject Matter

3. Claims 1-4 and 13-16 are allowed. The following is an examiner's statement of reasons for allowance: regarding claim 1, the prior art does not teach or suggest a manufacturing method of a semiconductor device, having all the limitations of claim 1, including forming on the dielectric film made of fluorine-added carbon an adhesion layer

including silicon and carbon; forming on the adhesion layer a protective layer comprising a nitrogen-added silicon carbide film; and depositing on the protective layer a film made of oxygen-added silicon carbide. Claims 2-4 and 13-16 depend from claim 1 and are allowable for the same reasons.

The closest is US 6,429,518 B1 (“Endo”), which was discussed in the previous office action. In Endo, Figs. 12 and 13 show a Cu/CF/SiC/SiCN/SiN/Cu structure, which is similar to that which is claimed. Also, the films **810-840** are disclosed to increase the adhesion between the CF **710** and the SiN **720**, a similar goal to that of the present invention. However, Endo differs from the claimed invention as Endo does not disclose a SiCO (oxygen-added silicon carbide) film; also, the top insulating film (SiN) hasn’t been disclosed for use as a hard mask, just an interlayer-insulating film.

Endo has previously been combined with 2003/0003765 A1 (“Gibson”), who has a SiCN film **11** and SiCO film **13** on top of it. However, Gibson’s reason to have **13** is disclosed as to prevent N-H bonds from layer **11** to diffuse to layer **17** and to photoresist above it, wherein **17** is a low-k dielectric. The SiN in Endo isn’t a low-k dielectric and there isn’t evidence that N-H bonds would diffuse through it. Also, claim 1 requires the the SiCO film is formed into a hardmask by etching. In Gibson, **13** is called a barrier, and it isn’t used as a hardmask. Thus, one of ordinary skill in the art at the time of invention would not have combined these references to reach the claimed method of claim 1, which requires the oxygen-added silicon carbide film on the nitrogen-added silicon carbide film and “obtaining a hardmask having a predetermined pattern by etching the film”.

The double patenting rejection over 12/157795 (US 2008/0246125 A1) made in the previous action is not maintained, because the amendments to the claims make the scope different. Claims 1-4 of 12/157795 do not require etching to form the hardmask with a predetermined pattern.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

4. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Kevin Parendo, whose can be contacted by phone at (571) 270-5030 or directly by fax at (571) 270-6030. The examiner can normally be reached on Mon.-Thurs. and alternate Fridays from 7 a.m. - 4:30 p.m. EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Matthew Smith, can be reached on (571) 272-1907. The fax number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should

you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Kevin A. Paredo/
Examiner, Art Unit 2823
6/15/2010

/Hsien-ming Lee/
Primary Examiner, Art Unit 2823